Black Stains in Children: A New Classification and an Innovative Flowchart for Management and Recurrence Prevention

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Abstract

Exogenous black pigmentations, commonly referred to as black stains (BS), are an acquired oral pathology, prevalent among children.

The condition is characterized by black punctiform spots that are distributed variably on the lingual and vestibular surfaces of both deciduous and permanent teeth. These spots are predominantly located on the cervical third of the crown but can also be found on the middle third, until the crown third, of the affected tooth's crown.

These stains present a therapeutic challenge due to their high recurrence rate and the often-insufficient oral hygiene practices among children and their caregivers. Although general dentists may not be familiar with the classification of BS, the clinical diagnosis of this condition is typically straightforward. There is still no consensus among researchers regarding the prevalence of BS, and the etiopathogenesis of this condition remains not fully understood. Although BS are not a serious pathology, many children and their families experience significant embarrassment, anxiety, and negative psychological effects due to the condition. Recent literature on the treatment of BS indicates that a universally effective clinical protocol has not yet been established. This study introduces a new classification based on therapeutic approach and a flow chart designed to assist paediatric dentists in managing BS with a focus on preventing recurrence.

KEYWORDS Black Stains, Children, Classification, Flowchart, Management, Recurrence Prevention.

Introduction

Exogenous black pigmentations are characterised by black punctiform spots variably distributed on the lingual and vestibular surfaces of both deciduous and permanent teeth [Gasparetto et al., 2003]. These spots predominantly occur on the cervical third of the crown but can also be found on the middle third, extending to the crown third, of the affected tooth's crown (Fig. 1-3). When these pigmentations become visible, they can compromise children's aesthetic appearance, impacting their personality and self-esteem [Heinrich-Weltzien et al., 2009]. Pinkerill first described these pigmentations in 1923 as a thin, dark brown stained line around the necks of the teeth. He suggested their presence as a sign of immunity to tooth decay. However, in clinical experience, cases of black stain (BS) associated with carious pathology are not uncommon (Fig. 4). A descriptive cross-sectional study suggest that black stains are a protective factor for early childhood caries [Elelmi et al., 2020]. A recent systematic review and meta-analysis has highlighted that the protective effect of black stain (BS) against dental caries, probably due to a significant predominance of chromogenic bacteria compared to those responsible for tooth decay, is questionable [Chen et al., 2021]. Instead, it appears that children at low risk of dental caries are more likely to develop BS because their oral microbiome favors the organisms that form it [Mousa et al., 2022]. The lingual surfaces of the mandibular teeth are the most frequently affected by BS. This is likely due to their proximity to the submandibular salivary glands and the role of saliva in the aetiology of BS. In young individuals, BS sometimes tends to regress with puberty and the transition to adulthood [Heinrich-Weltzien et al. 2009]. Familiarity in black stains (BS) was first described by Gasparetto in 2003. This research highlighted the potential genetic or familial predisposition to the development of BS, suggesting that the condition may be more common among individuals with a family history of the condition. It also appears that there may be a direct transfer of chromogenic bacteria through saliva or an indirect transfer via tools such as toothbrushes or cutlery; however, it is important to consider that family members often share similar dietary and oral hygiene habits, which could explain the presence of BS within the family [Natoli, 2019]. The first classification of black stains dates back to 1947 by Sourie, followed by Hoch in 2001, with the most recent classification by Gasparetto in 2003 being the one currently in use [Gasparetto et al., 2003]. Gasparetto's classification categorises black stains (BS) into three distinct scores based on their clinical position and extent:

- Score 1: Pigmented spots or a thin line with incomplete coalescence, parallel to the gingival margin.
- Score 2: Continuous pigmented lines limited to the middle of the cervical third of the tooth surface.
- Score 3: Pigmented spots extending beyond the middle

of the cervical third.

From a clinical perspective, this classification does not encompass a significant portion of observable cases, particularly the more complex ones and instances of recurrence, which are quite frequent and require a different type of intervention. For this reason, this study proposes a new classification that includes four different scores.

Proposed Classification Based on Therapeutic Approach Suggested by Zerman

The rationale for this new classification proposal is grounded in the correlation between the scores identified in specific clinical cases and their association with various clinical issues, alongside the corresponding therapeutic approaches required.

Specifically, clinical cases of Black Stains (BS) that do not present with concomitant caries require a comprehensive oral hygiene approach, managed by a paediatric dentist, regardless of the extent of pigmentation. Frequent cases of BS associated with carious pathology warrant a distinct score, as they necessitate a therapeutic approach that specifically addresses the treatment of caries and its secondary prevention. Furthermore, when pigmentation affects both the vestibular and lingual surfaces, a psychological component is introduced. This psychological aspect can be leveraged to address and resolve the case more effectively. Finally, because treating BS effectively remains challenging for dentists and dental hygienists due to the high likelihood of recurrence after professional treatment, clinical cases of recurrence—defined as the reappearance of black spots on teeth after treatment—should be assigned a specific score. The proposed treatment flowchart may be crucial for resolving these more complex cases, which can significantly impact the patient's quality of life.

Zerman' Classification of BS

- Score A: Pigmented lines or spots extended on buccal surface.
- Score B: Pigmented lines or spots extended both on lingual and buccal surfaces.
- Score C: Pigmented lines or spots with concomitant caries.
- Score D: Recurring Pigmented lines or spots.

The diagnosis has never been particularly complicated, even for less experienced dentists. This is due to the typical clinical presentation of black stains (BS), which rarely requires differential diagnosis with stains caused by consuming tea, coffee, smoking, poor oral hygiene, and pharmaceutical products (such as chlorhexidine mouthwashes and iron supplements). Similarly, internal pigmentation is unlikely to be confused with the dark internal colouration seen in amelogenesis imperfecta, dentinogenesis imperfecta, and tetracycline pigmentation. It is essential for both dentists and dental hygienists to have a thorough understanding of black spots on teeth to ensure accurate diagnosis and appropriate treatment, or referral to a specialised paediatric clinic if necessary. When addressing these spots, two primary concerns are commonly recognised among dental professionals: first, the frequent recurrence of the spots, and second, the need to prevent any iatrogenic damage to the tooth or surrounding oral tissues during treatment. The literature lacks consensus on prevalence rates, which range from 2% to 20%, with an equal distribution observed between males and females [Martin et al., 2013; Koch et al., 2001; Gasparetto et al., 2003; Elelmi et al. 2021]. It probably depends on the type of diet as well as on oral hygiene habits, so different in the studies considered. The etiopathogenesis is not fully understood. Several factors are considered, including bacteria and their metabolic byproducts, diet, the chemical composition of saliva, particularly its mineral content. Inadequate oral hygiene is a constant report. Indeed, no clinical cases of BS have been reported under conditions of optimal oral hygiene, where bacterial plaque is completely absent [Zhang Y et al. 2022]. The microflora associated with BS is primarily composed of chromogenic bacteria, including *Actinomyces* and various species of *Prevotella* such as *P. nigrescens*, P. *melaninogenica*, *P. gingivalis*, and *P. intermedia* (Zheng et al. 2023; Chen et al. 2019; Saba et al. 2006). The composition of the microflora of exogenous black pigmentations in children has also been studied with metaproteomics (Hirts et al. 2022).Advanced microbiological research techniques have been employed to study the oral microbiota in children with type 1 diabetes mellitus who also suffer from dental and periodontal diseases [Carelli et al. 2023]. Additionally, a recent systematic review by Dong et al. (2024) proposed the concept of a 'core microbiome' and highlighted the presence of many other bacteria including *Pseudotropinibacterium, Leptotrichia, Rothia, Cardiobacterium, Haemophilus, Corynebacterium, Tannerella, Treponema, Fusobacterium, Streptococcus, Neisseria, Capnocytophaga, Pseudomonas fluorescens, Aggregatibacter Prevotella, Bacteroides, Kingella and Lautropia*. Data on the chemical composition of saliva in individuals with BS are limited. However, saliva in these individuals exhibits elevated concentrations of calcium, sulfur, copper, and iron, as well as increased buffering capacity. These factors may contribute to the formation of intensely coloured compounds [Veses et al., 2020]. The black pigmentation observed in BS is attributed to deposits of ferric sulfate, which result from reactions between bacterial metabolic products and iron in saliva. Among these metabolic products, hydrogen sulfide is particularly noteworthy; it reacts with iron available in saliva, especially under pathological conditions involving iron metabolism disorders, forming black precipitates of ferric [Han et al. 2021]. Some studies suggest an increased prevalence of BS associated with the consumption of certain iron-rich vegetables, dairy products, and fruits [Żyła et al., 2015]. In Brazil, consuming tap water rather than bottled mineral or natural well water has also been associated with a higher prevalence of BS [França-Pinto et al., 2012]. Garcia Martin et al. [2013] reported that the use of toothpaste and mouthwash containing fluoride may promote the formation of stains [Martin et al., 2013]. Subsequently, Tripodi et al. [2016] found that children with BS had a higher fluoride intake compared to controls. The pathogenesis of BS remains unclear because current research methods cannot fully identify the complex composition of the microbial community. Third-generation sequencing and comprehensive multiomics studies, such as macrogene sequencing, macroproteomics, metabolomics, and transcriptomics, are needed. Once the relevant pathogenic microorganisms have been identified, the relationships between these microbes and the different chemical constituents involved should be established [Dong et al., 2024].

Treatment of BS

The effective treatment of BS remains a challenge for dentists and dental hygienists due to the high likelihood of recurrence after professional treatment. Ultrasonic scalers, along with polishing pastes and powders applied via air and water jets, can effectively restore the natural, healthy surfaces of teeth. However, these treatments offer only temporary results, as the

deposits often reappear. Some predictive factors for recurrences have been identified in our clinical experience:

- Non-cooperative primary caregiver: for example, a case managed by a caregiver who believes they know everything and relies on information from the internet.
- Alternative reason for the visit: for instance, in Figure 3, the visit was prompted by a unilateral crossbite, not BS.
- Low level of parental education: this is generally associated with a higher prevalence of BS, although some studies have reported contradictory findings [Heinrich-Weltzien et al., 2009].

These factors highlight the importance of targeted interventions in managing BS effectively.

Therapy techniques

There is not yet a therapy protocol that considers the cost-benefit ratio and promotes family responsibility. The literature contains a series of recommendations and advice, such as avoiding hard brushing or using hard toothbrushes or improper use of substances considered whitening, such as lemon, bicarbonate, and sage, which are harmful to the enamel, to prevent acquired enamel abrasions [Pessoa et al., 2015].

Several treatment options have been described in the literature, including micro-abrasion with abrasives (e.g., air jet polishing) [Weaks et al.,1984], photodynamic therapy (e.g., diode laser, Nd:YAG laser) [Pessoa et al., 2015], antimicrobial therapy (e.g., lactoferrin and lacto-peroxidase tablets) [Nakano et al., 2017; Sangermano et al., 2019]. Additionally, an emerging therapy to prevent the development or recurrence of chromogenic staining involves using an oral probiotic, specifically *Streptococcus salivarius* M18 [Bardellini et al., 2020]. As is often the case, historical trends tend to repeat themselves, and air jet polishing, which was widely used in the 1980s [Weaks et al., 1984], has regained popularity. It is now utilised not only for the atraumatic removal of the BS but also in the treatment of periodontitis [Pardo et al., 2023]. In more complex clinical cases, characterised by significant pigmented deposits and involving very young children, air polishing is the preferred technique due to its speed, effectiveness, and good tolerance compared to more invasive techniques like ultrasonic or photodynamic therapy. Moreover, it is less damaging to enamel compared to ultrasound techniques. Photodynamic therapy (PDT), proposed by Pessoa in 2015, is a rather complex technique involving five sessions with a diode laser, one per week. Prophylactic treatment is applied to proximal areas. After performing PDT, remaining pigmented spots are removed using Gracey curettes. Therefore, not only are the five PDT sessions insufficient on their own, but it is also necessary to carefully remove the photosensitising toluidine blue solution— which must be procured and is not entirely harmless— using prophylactic paste and a rubber cup. Furthermore, PDT therapy can cause areas of enamel demineralisation, leading to hypersensitivity, necessitating the application of topical neutral fluoride. Although photodynamic therapy can reduce levels of pigmenting bacteria and gum inflammation, it requires a lengthy and complex procedure. Lactoferrin (LF) and lacto-peroxidase (LPO) are antimicrobial proteins present in saliva, and their influence on the entire oral microbiota has been the subject of research. In a randomised, double-blind, placebo-controlled study [Nakano et al., 2017], the effects of long-term ingestion of tablets containing LF and LPO on the microbiota of supragingival plaque and tongue coating in elderly individuals were evaluated. In the test group, significantly lower microbiota diversity was observed in supragingival plaque at 8 weeks compared to the placebo group. The results indicated that tablets containing LF and LPO promote a shift from a highly diverse, gram-negative dominated community to a gram-positive dominated community in the microbiota of the supragingival plaque and tongue lining. Sangermano et al. [2019] studied the use of lactoferrin (Lf) in the dental field, particularly for treating Black Stain (BS). A supplement combining lactoferrin and D-biotin can be an effective and innovative therapy for this harmless but unsightly condition. It works by sequestering excess ferric ions in the saliva and controlling bacteria that depend on iron for their growth. There is strong evidence that iron-enriched foods or vitamin complexes containing iron increase the availability of this element, thereby increasing the likelihood of forming ferric sulfide, which appears as black pigment deposits on the tooth surface [Valenti et al., 2016]. The study also highlights the potential for microbial exchange between family members, which can occur directly through close contact or indirectly through shared items such as toothbrushes, cutlery, or glasses. To counteract the recurrence of black stains (BS), a randomised controlled study evaluated the efficacy of the oral probiotic *Streptococcus salivarius* M18 (SsM18), administered once daily for three months after professional BS removal [Bardellini et al. 2020]. In the control group, which did not receive any treatment, 50% of cases relapsed after 3 and 6 months, compared to 20% and 30%, respectively, in the probiotic-treated group, showing statistically significant differences. The study demonstrated that the formation of BS in children could be at least partially prevented by administering *S. salivarius* M18. It is important to note that the cost for families may not be negligible. Additionally, the therapeutic principle of administering a product may reduce the caregiver's responsibility for maintaining meticulous home oral hygiene, which is believed to be essential for avoiding recurrence. A therapeutic flow diagram proposed by Januia et al. [2022] is based on the authors' experience and is not evidence-based due to the limited research in this area. The author describes a clinical case involving 2-year-old monozygotic twins, only one of whom was affected by BS. The protocol described emphasises the importance of a correct diagnosis to reassure the patient about the cause of the staining and to clarify that it is not permanent. After providing preventive tips and advising against excessive brushing habits, polish with prophylaxis paste, avoiding excessive use of ultrasound to prevent iatrogenic harm. Note that it may not be possible to remove all stains and inform the patient that stains may recur. Finally, establish a recall schedule and repeat the previous steps if necessary. This interesting study highlights the potential aesthetic concerns for young patients, minimises the operational difficulty of more extensive cases in very young children, and addresses the problem of recurrence by recommending repetition of the described steps. Given that proper oral hygiene at home prevents plaque accumulation and consequently the formation of Black Stains (BS), why use a drug or supplement such as lactoferrin or *Streptococcus* M18?

This becomes an unnecessary cost and may negatively influence caregivers by reducing their commitment to maintaining oral hygiene. This situation is similar to the administration of systemic fluoride tablets, which was promoted instead of encouraging proper home oral hygiene and less invasive local applications of fluoride varnishes and gels, only in cases at risk of caries [Ferro et al., 2014; Tomasin et al., 2015]. *Streptococcus* M18 and lactoferrin can be helpful in specific cases of Molar Incisor Hypomineralisation (MIH) or in individuals with autism spectrum disorders [Zerman et al., 2022] or other

conditions that make daily oral hygiene maintenance difficult for patients or caregivers [Ludovichetti et al., 2023]. Furthermore, children who may have recently received treatment for BS might have been included in control groups, as the studies in question did not account for their treatment history. More than 30 years after the adoption of the United Nations Convention on the Rights of the Child in 1989, it is imperative to establish guidelines that ensure a child's active consent to health treatments in all cases where it is feasible, considering the patient's age and circumstances [Paglia, 2024].

Recurrence of BS

The tendency of BS to recur is a phenomenon well documented by many authors, first described by Heinrich-Weltzien and colleagues in 2009. Black pigmentation can recur immediately after removal if the patient does not follow the correct home oral hygiene procedures and dietary advice received. Just 2-3 days of poor oral hygiene are enough for plaque to remain deposited and begin transforming into calculus. The follow-up which is generally expected 3 months after the professional hygiene session with removal of the BS, is therefore too long. A home oral hygiene regimen, often recommended, which involves brushing with fluoride toothpaste twice a day under parental supervision, may not be sufficient. The issue extends beyond:

- Inadequate manual skills on the part of the child: generally, children do not develop sufficient manual skills until the age of 7 or 8. In this context, it is important to emphasise the need to monitor the caregiver's manual skills [Ludovichetti et al., 2022]. Parents are often primarily responsible for the inefficient management of oral health [Paglia, 2019]. This inefficiency affects both young patients and the parents themselves. Many authors have established a strong connection between multiple early cavities and the negligence or incompetence of caregivers [Karst et al., 2022; Zerman et al., 2024; Zuccon et al., 2022; Zuccon et al., 2023; Ludovichetti et al., 2022].

Dental floss should be used consistently, especially for cleaning the interproximal lateral areas of the mouth.

- Tight deciduous dentition: in cases where teeth are closely spaced, dental floss should also be recommended for the anterior regions, which are often more susceptible to plaque accumulation and subsequent BS recurrence.
- Associated carious pathology: for cases where cavities are present, proper oral hygiene practices should be performed after every meal or snack. It is crucial to minimise the intake of free and added sugars. This recommendation is vital to reinforce proper dietary habits, encouraging caregivers to structure food intake just only into five distinct periods throughout the day: breakfast, lunch, dinner, and two snacks.

These recommendations emphasise the importance of changing poor oral hygiene and dietary habits at home, which contribute to the development of both cavities and black stains (BS). Caregivers should be educated on the significance of maintaining these habits to prevent the recurrence of dental issues.

A novel flowchart for managing and preventing recurrence

The new flowchart for managing recurrences can be particularly beneficial in more complex cases that affect the patient's quality of life. The biological principle is straightforward: chromogenic bacteria colonise dental plaque, depositing black pigments on enamel in areas where plaque accumulates. Professional Oral Hygiene removes plaque and, consequently, the bacteria responsible for the pigmentation. In children with recurring Black Stain (BS), classified with a D score according to the new classification, following a structured 8-point therapeutic protocol may prove useful.

1. Dietary History and Oral Hygiene Habits: a questionnaire is administered to caregivers to assess the dietary and oral hygiene habits of children diagnosed with Black Stains (BS). Over more than 30 years of professional practice, these habits have consistently been found inadequate. A simple and concise questionnaire, as presented in Table 1, is given to caregivers. Analysis of the responses reveals insufficient oral hygiene practices, with children under 5-6 years old often left alone during oral hygiene routines, which are sometimes not performed daily. Similarly, dietary habits are generally unhealthy, with frequent consumption of packaged foods rich in simple sugars. This critical data allows us to optimise oral hygiene instructions and provide advice for healthier dietary habits. This approach aims not only to improve oral health and understand the causes of BS but also to positively influence the overall health history of the patient.
2. Photos of the dental arches and tongue, before and after professional oral hygiene. Photos of the dental arches documents the presence and extent of BS, useful both for planning therapy and for follow-up in case of recurrence. Furthermore, the photos of the tongue

• Frequency of dental visits:	A) When there is a problem	B) At least 1/year for prevention	C) Rarely/never
• Brushing teeth:	A) Alone	B) Supervised	C) Parent/caregiver
• Brushing teeth frequency:	A) Twice a day	B) One a day	C) Rarely
• Type of toothbrush:	A) Manual	B) Electric	C) Suggested by dentist or hygienist
• Tongue brushing:	A) Daily	B) Rarely	C) Never
• Use of fluoridated toothpaste:	(yes)	(no)	
• Use of dental floss:	A) Daily	B) Rarely	C) Never
• Use of mouth rinse:	A) Daily	B) Rarely	C) Never
• Meal consumption:	A) Up to 3/day	B) Up to 5/day	C) >6/day
• Frequency of sugary snacks:	A) Up to 3 times/week	B) 4–5 times/week	C) Every day
• Pre-cooked or packaged foods:	A) Rarely	B) Every day	C) Every week

TABLE 1 A Questionnaire of dietary history and oral hygiene habits. Oral health behaviours of children as reported by parents or caregivers in both BS



FIG 1. A 22-month-old boy presents with calculous accompanied by initial punctiform black pigmentations. This condition is classified as Score 1 by Gasparetto, corresponding to Score A by Zerman. Treatment involves manual removal using Gracey curettes, followed by polishing with prophylaxis paste and rubber cups. Caregivers should be motivated and educated on the importance of maintaining proper oral hygiene at home, as outlined.
FIG. 2. BS on deciduous dentition. The pigmentation is predominantly distributed on the mandibular lingual surfaces, extending to the third crown surface, and is also present on the vestibular surface. This corresponds to a Gasparetto score of 3, which equates to a Zerman score of B. A case with a B score requires a specific professional oral hygiene intervention, including thorough removal of the deposits and motivational involvement of caregivers in the essential use of dental floss.
FIG. 3. A case of partial distribution, including the buccal surface, classified as Score B in Zerman' classification. According to Gasparetto, this could be scored as 1 or 2. It is important to note the potential aesthetic damage, which generally makes the therapy more acceptable to patients and parents.



FIG. 4. BS on deciduous dentition presents as black punctiform spots along the cervical region of all teeth, corresponding to a Gasparetto score of 2. Notably, concurrent carious lesions are observed between the upper central incisors. While Gasparetto does not assign a specific score for caries, the new Zerman classification assigns a score C. A case with a C score necessitates a multidisciplinary approach involving both a dental hygienist and a paediatric dentist.
FIG. 5. Case of recurrence classified as Score D in the Zerman' classification. Gasparetto's classification does not include a specific category for this situation. It is crucial to address these cases using a stringent protocol established by the practice, rather than treating them as primary case.
FIG. 6: Presence of calculous at 10 months of age. Early detection of such cases is crucial. This patient was the younger sister of a 3-year-old boy who was attending a visit for BS.

highlight the concomitant presence of a microbial layer which reinforces the concept of inadequate hygiene.

3. Professional Oral Hygiene:
- in the most collaborative cases: Use ultrasound, pumice paste, cups, rubbers, and polishing disks.
- In more complicated cases due to early age and degree of collaboration: Use air polishing, curettes, and rubber polishing. The professional oral hygiene session includes reinforcing oral hygiene instructions and dietary advice and should, if possible, involve both parents or the primary caregiver responsible for the child's home hygiene. For very young children, it is essential to use minimally invasive, quick, painless, and effective techniques. Manual removal with curettes is preferable for modest quantities of BS affecting a few dental elements.

4. Home Oral Hygiene Instructions with Monitoring of Caregiver Manual Skills: caregivers must learn how to properly brush and floss their child's teeth, as well as correctly brush the tongue once a day (Ren et al 2016). It is a common misconception that caregivers automatically know how to correctly perform these tasks, especially when it comes to brushing the tongue.
5. Dietary Instructions: avoid or limit foods and drinks rich in iron and simple sugars. If consumption is necessary, brush the child's teeth afterward.
6. Topical application of uncoloured mousse with amorphous calcium phosphate should also be used at home once a week after thorough brushing in the evening.
7. 15-Day Food Diary: the caregiver records everything the child eats and drinks, including snacks and beverages outside of main meals, as well as any medications or supplements (excluding water). This diary serves two purposes: it helps the caregiver understand the relationship between the child's diet and the potential recurrence of BS, and it can encourage healthier eating habits, which is particularly beneficial if the child is overweight, a common concern (Llena et al. 2014).
8. Follow-up After 15 Days: After 15 days, conduct a clinical

evaluation to check for the absence of recurrence, review the food diary from the previous 15 days, and evaluate the absence of bacterial plaque on the teeth and tongue coating. It is recommended to take new photos for comparison with the initial one. This process makes both the caregivers and the young patient responsible for understanding the connection between poor hygiene, unhealthy eating habits, and BS. Additionally, if the food diary has not been completed, it signals the need for motivational reinforcement for the caregivers. If we truly want to contribute to reducing the high consumption of unhealthy diets among children, it's not enough to occasionally ask caregivers what they eat. Instead, we need to have them complete a 15-day food diary.

Numerous hypotheses have been proposed regarding dietary habits that may contribute to BS. High consumption of dairy products and soft drinks has been implicated, while other suggestions include fruit and vegetables, soy sauce, tap water, and the intake of iron and calcium supplements. To identify potential dietary factors contributing to recurrence after professional oral hygiene, it is essential to closely monitor what the child consumes through a detailed 15-day food diary.

Conclusions and Future Perspectives

Black Stains (BS) have been the focus of research since the early 20th century, beginning with Bibby's influential work in 1931. Despite this longstanding interest, BS remain a common and persistent issue among children, characterised by their acquired yet often perplexing nature. While substantial progress has been made in understanding certain aspects of BS, many critical elements remain unresolved, particularly concerning their formation mechanisms, risk factors, and chemical composition. Furthermore, the specific oral microbiome associated with BS in children is still not fully understood, highlighting a significant gap in our comprehension of this condition. Children are inherently unable to eliminate BS on their own, necessitating the involvement of professional oral hygiene interventions. The effectiveness of these interventions has been well-documented, yet BS's notorious tendency to recur poses ongoing challenges. This recurrence is not merely an aesthetic issue; it has significant psychological implications, potentially affecting the self-esteem and social interactions of affected children. Given these challenges, there is a pressing need for a well-defined clinical protocol tailored to manage complex cases of BS effectively. Such a protocol would not only standardise care but also address the current gap in clinical practice, ensuring that children receive the most appropriate and effective treatment. The aetiology of BS remains a subject of debate and investigation. Current theories suggest that BS may involve the deposition of iron compounds, the production of black pigments through oral bacterial metabolism, or the formation of metabolites via chemical reactions within the oral environment. However, these theories have yet to provide a definitive understanding, highlighting the need for ongoing research. Advanced techniques, such as third-generation sequencing, offer promising avenues for exploring the macrogenes, macroproteomes, metabolomes, and transcriptomes associated with BS. By leveraging these cutting-edge technologies, researchers may gain more consistent and comprehensive insights into the core microbiome linked to BS, potentially unveiling new targets for prevention and treatment.

Advancing our understanding and management of BS hinges on the integration of epidemiological data with the clinical expertise of dental professionals. By combining these insights in a multidimensional approach, significant progress could be made in both the prevention and treatment of BS. Such an approach would enable researchers and clinicians to develop more targeted strategies that cater to the specific needs of each patient, ultimately enhancing outcomes and minimising the recurrence of BS. Given the recurrent nature of BS, an effective solution has been developed to manage cases of relapse. This approach underscores the importance of ongoing care and monitoring, ensuring that patients receive continuous support to prevent the reappearance of BS. Future research should aim to refine this strategy, incorporating new insights as they emerge from ongoing studies. Additionally, investigating the influence of environmental factors, dietary habits, and genetic predispositions could further deepen our understanding of BS and lead to more personalised treatment approaches. In conclusion, while considerable progress has been made in the study of BS, much work remains to be done. By continuing to investigate the complex interplay of factors that contribute to BS, and by enhancing our clinical protocols, we can better meet the needs of children affected by this condition, ultimately improving their oral health and overall quality of life.

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